Optical Properties and Chemical Composition of Native-Oxide Layer on the Surface of GaAs Irradiated with Noble Gases

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Monocrystalline (100) semi-insulating gallium arsenide (GaAs) samples were irradiated by noble gases (He^+, Ne^+, Ar^+, Kr^+ and Xe^+) ion beam. The energies of the ion beams were 100, 150 and 200 keV, respectively. The irradiation was performed at a room temperature using a fluence of 1×10^{16} ions/cm^2. Because, noble gases have complete valence shells and do not form any new chemical bonds with the target atoms (Ga and As), the interaction with implanted atoms does not result in the production of any new chemical compounds. This is why noble gases were used in this research. To investigate the formation and growth of native oxide layers on samples before and after implanting, the spectroscopic ellipsometry (SE) method and X-ray photoelectron spectroscopy (XPS) method were used. The SE method demonstrates that the optical properties of the native oxide layer on the surface of GaAs samples vary with ions and energy. We found that the mass of the ion used in the implantation process has an effect on both the shape and the values of the imaginary part of the optical properties. XPS approach, which reveals the chemical composition of native oxide layer on the surface of GaAs samples, confirms that the native oxide layer on GaAs samples is a mixing of Ga_2O_3, As_2O_3, As_2O_5 and GaAs compound. The concentration of these compound various with ion mass.

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